

- Each component operation involves at least one component part. Typically there is an active part that initiates or maintains the operation (and may be changed by it) and at least one passive part that is changed by the operation. The change may be to the location or other properties of a part, or it may transform it into another kind of part.
- Mechanisms may involve multiple levels of organization.
- Operations can be organized simply by temporal sequence, but those in biological mechanisms tend to exhibit more complex forms of organization.
- Mechanisms can be dynamic and can change both ontogenetically and phylogenetically.

Several features of this characterization of a mechanism require elaboration.

### *Mechanisms Explain Phenomena*

The conception of a mechanism is intimately tied to the context of explanation: Mechanisms are identified in terms of a phenomenon for which explanation is sought. In logical empiricist philosophy of science there was a tendency to construe explanations as explaining observation statements, which were taken to be theory-neutral characterizations of events. This view became problematic with the contention, stemming from Hanson (1948) and Kuhn (1962/1970), that observations are theory-laden in that what scientists observe is influenced by the theories they hold. This seemed to threaten circularity with theories being tested by observations that are already shaped by the theories being tested. Although there are simpler ways of showing that this circularity is not vicious,<sup>3</sup> Bogen and Woodward challenged the very idea that observations are what scientists explain. They contrasted observations and phenomena. Observations provide data but – except when the data does not turn out as expected and the investigator seeks to explain why – it is not data that scientists explain. Rather, they explain *phenomena* – occurrences in the world about which data can be procured.<sup>4</sup> Although there can be singular phenomena (the big bang or the birth of a particular organism), the

<sup>3</sup> For example, it is sufficient to note that even if the way in which we observe something is affected by our theories and other beliefs, this does not entail that we can observe whatever the theory predicts. Holding a theory that grass turns red in normal daylight will not make it the case that I will see red grass.

<sup>4</sup> Some purported phenomena do not exist. Bogen and Woodward cited the example of N-rays, a phenomenon that French physicists at the beginning of the twentieth century posited on the basis of several observations; ultimately, more careful data collection demonstrated that such a phenomenon did not exist.